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MONTHLY PROJECT STATUS REPORT

Covering the Period

March 4 to April 4, 1963

CONTAMINATION EXPOSURES OF Cb-1Zr ALLOY SPECIMENS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONTRACT NUMBER NAS 3-1903

SPACE POWER AND PROPULSION SECTION

RE-ENTRY SYSTEMS DEPARTMENT

GENERAL ELECTRIC COMPANY

CINCINNATI 15, OHIO

COLUMBIUM

CONTAMINATION EXPOSURES OF Cb-1Zr ALLOY SPECIMENS

NASA CONTRACT 3-1903

EXPERIMENTAL APPARATUS

ZIRCONIUM

The first two 10^{-6} torr range oxygen exposures have been completed successfully, and the apparatus remains in good condition. There appears to be very little devitrification of the quartz tube; the ion gauge filament appears to be in good condition, but the spectrometer tube filament has dropped from 5 amps AC to 4.2 amps AC. We experienced short filament life in the 10^{-5} torr range during the previous exposures. One of the ion gauge panels was replaced to improve emission regulation, and a pressure recorder was revamped. When the spectrometer tube was checked out after Specimen No. 24 was baked-out at 400°C , it was found that there was no draw-out potential in the ion source, and a diode and a potentiometer were replaced.

EXPERIMENTAL PROCEDURE

A gas composition chart, an oxygen consumption plot, and a pressure plot for the first run (Specimen No. 23) are included. At Mr. Barrett's request on his visit of March 18, 1963, the calculations of the conductance between the two ion gauges are enclosed. It should be noticed that the conductance was calculated for oxygen flow. The ion gauges are calibrated for dry air, and to correct for oxygen flow the Δ Pressure was divided by 0.8. This factor was obtained from C.V.C. in Rochester, N. Y. for the G.I.C. Oll gauge that is used. Before admitting oxygen, there was no readable difference between the two gauges when on the 10^{-6} torr range.

Specimen No. 23 was removed with the number facing downward. A flow of dry nitrogen was maintained during the removal of the first sample and the installation of the second. The total time for the first run was 236 1/2 hours of oxygen exposure. Just prior to admitting oxygen to Specimen No. 23, the gas composition was as follows; and the total pressure was in the mid 10^{-8} torr range.

$$\text{H}_2\text{O} = 74.2\%$$

$$\text{H}_2 = 21.5\%$$

$$\text{CO} = 4.3\%$$

Specimen No. 24 was installed on 3-15; system baked-out at 400°C to 3-16; quartz furnace on 3-16; specimen inserted on 3-20; oxygen

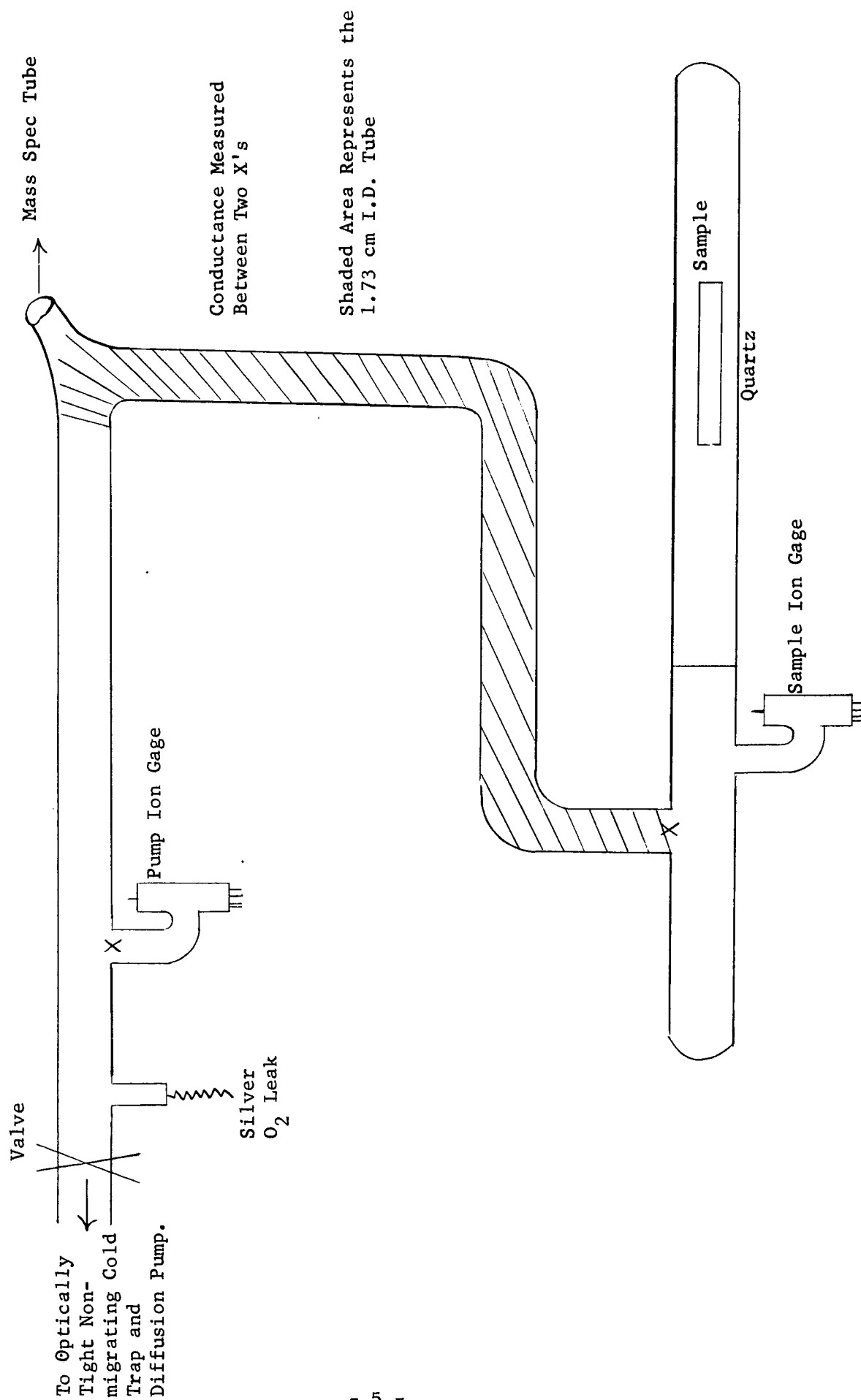
introduced on 3-22 at 4:00 p.m.; and the run was completed at 12:00 noon on April 1. This second run is also a low 10^{-6} torr exposure, but with the furnace set at 980°C . The details of the exposure will be presented in the next monthly report.

The third run is in the preoutgassing phase at this time, and an exposure to 10^{-7} torr oxygen pressure is planned.

SCHEDULE AND FINANCES

As mentioned previously, the set-up, calibration, and check-out phase has taken longer than was anticipated, and it will be difficult to complete the five exposures during the remaining months of the program if additional problems are encountered. Expenditures of funds to reach the present status have been close to the original expectations.

FLOW DIAGRAM OF TUBING USED IN CONDUCTANCE CALCULATIONS



CONDUCTANCE CALCULATIONS COVERING THE TUBING BETWEEN THE TWO ION GAGES
IN THE SYSTEM USED FOR Cb-12r — O₂ CONTAMINATION - 3-63

TUBE: $C = 12.1 \frac{d^3}{L} \frac{l}{\text{sec}}$ FOR AIR

ORIFICE: $C = 9.1 d^2 \frac{l}{\text{sec}}$ FOR AIR

d = diameter-cm
L = length-cm
C = conductance-l/sec
l = liter

FIRST TUBE: d = 1.73 cm
L = 12.25 in = 31.1 cm
+ 3-90° elbows at 1.5 dia. each

then L = 31.1 + 4.5 x 1.73 = 38.9 cm

$$C_1 = 12.1 \frac{(1.73)^3}{38.9} = 1.61 \left(\frac{l}{\text{sec}} \right) \quad (\text{AIR})$$

SECOND TUBE: d = 1.2 cm
L = 7.5 in = 19 cm

$$C_2 = 12.1 \frac{(1.2)^3}{19} = 1.1 \left(\frac{l}{\text{sec}} \right) \quad (\text{AIR})$$

ORIFICE IN FIRST TUBE:

$$C_3 = 9.1 (1.73)^2 = 27.2 \frac{l}{\text{sec}}$$

TOTAL CONDUCTANCE:

$$\begin{aligned} \frac{1}{C_{\text{total}}} &= \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \\ &= \frac{1}{1.61} + \frac{1}{1.1} + \frac{1}{27.2} \\ &= 0.621 + 0.910 + 0.037 \\ &= 1.568 \end{aligned}$$

$$C_{\text{total}} = \frac{1}{1.568} = 0.638 \frac{l}{\text{sec}}$$

TO CORRECT FOR O₂ FLOW INSTEAD OF AIR

$$C_{O_2} = 0.638 \sqrt{\frac{28.7}{32}} = 0.638 \times .946 \frac{l}{sec}$$

$C_{O_2} = 0.604 \frac{l}{sec}$

TABLE I

GAS COMPOSITION DURING
THE EXPOSURE OF SPECIMEN NO. 23

10^{-6} Torr, - 1100°C - O_2 Admission

<u>Gas Composition, Percent</u>					
<u>Time, Hr. (1)</u>	<u>O_2</u>	<u>CO</u>	<u>H_2O</u>	<u>H_2</u>	<u>CO_2</u>
1 hr. 40 min.	92.1	0.3	3.7	0.9	3.
20 hrs. 53 min.	94.9	0.2	1.	0.3	3.6
69 hrs.	98	0.1	0.3	-	1.6
166 hrs. 18 min.	99.3	-	-	0.05	0.65
213 hrs.	99.3	-	0.2	-	0.5
236 hrs. 25 min.	99.3	-	0.2	-	0.5

(1) Time from the start of oxygen admission.

Gas Consumption Rate, Torr ℓ /sec

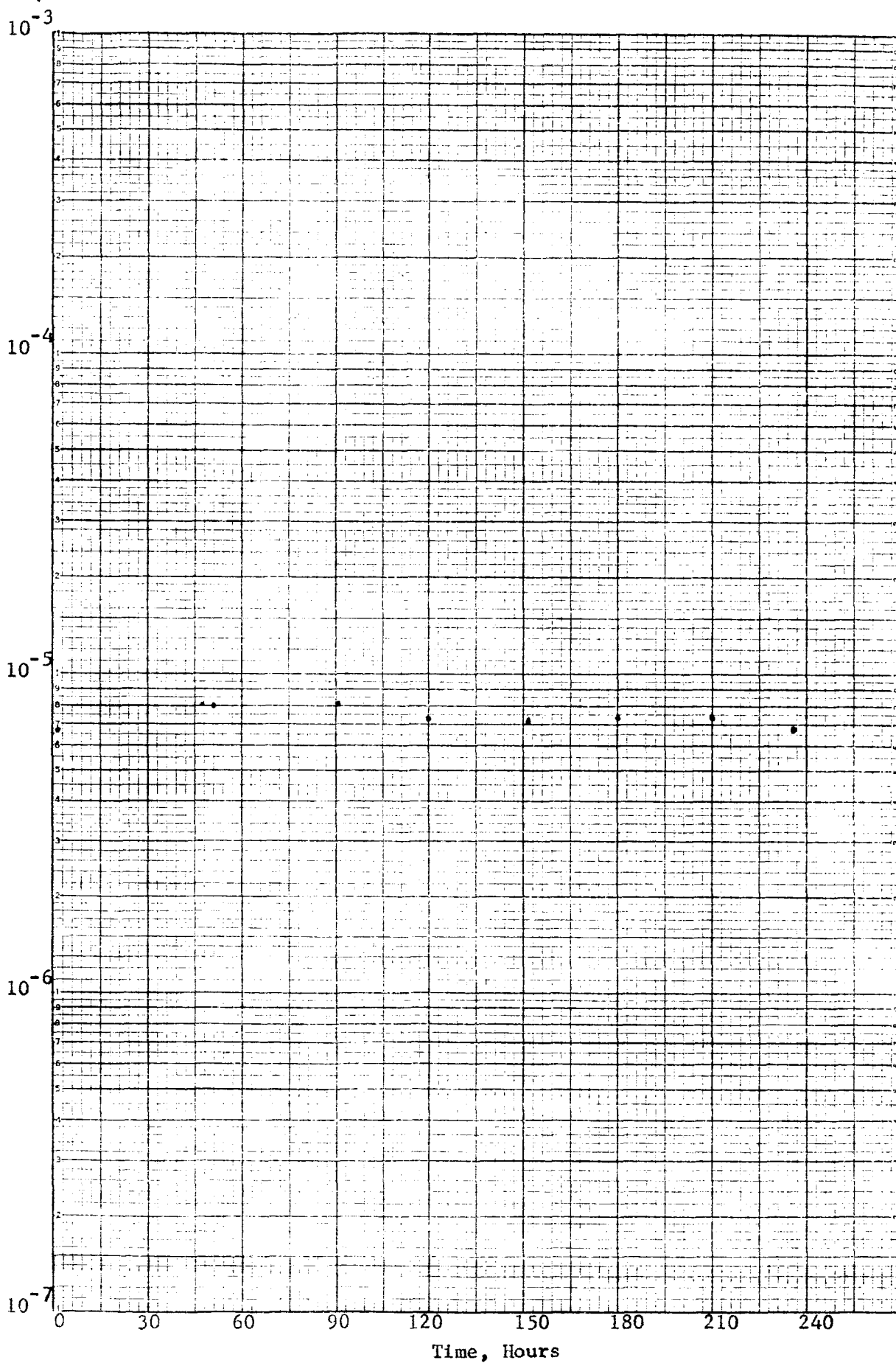


Fig. Exposure of Spec. No. 23 at 1×10^{-6} Torr and 1100°C with O_2 Admission.

Sample Ion Gage = X

Pump Ion Gage = ⊕

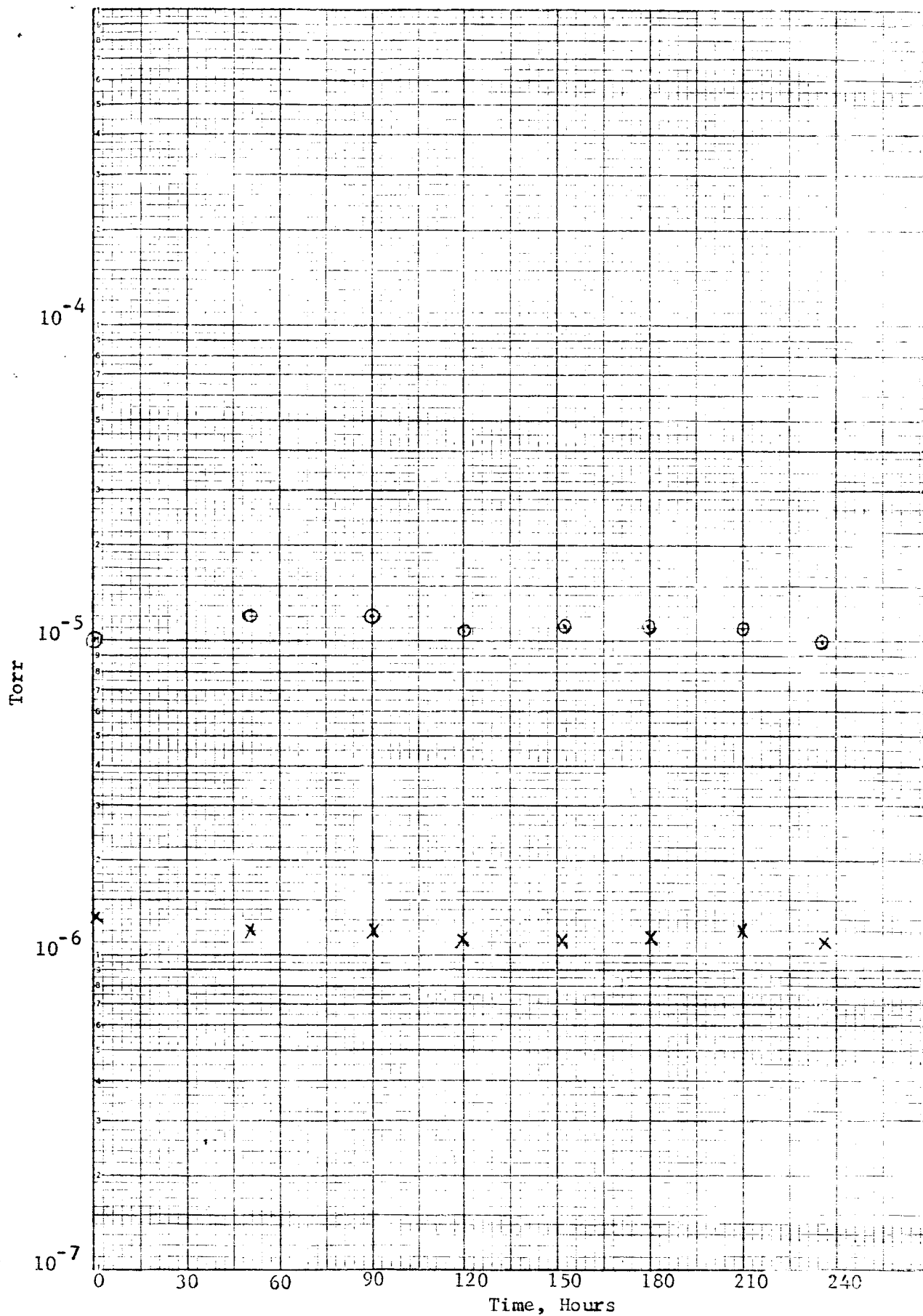


Fig. Exposure of Spec. No. 23 at 1×10^{-6} Torr and 1100°C with O_2 Admission.